Informing Vehicle Architectures with Diagnosability and Security

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Abstract

Parking, logistic structures or vehicle architectures which are significantly dominated by vehicles-probably crossing multi-stories, are essential for transportation and regional development. Mobile communication can be interfered by materials and technological applications. Nevertheless, underground secondary spaces are often set for them—consequently, accompanied with more fire fighting, tele-communication and terrorism issues. Hence, dual-surveillance based security-information networks, with wireless applications, via mathematical Spider-Web networks, SW(m,n), are modeled to be spatially integrated with structures' circulation patterns. Parallelism or mutually-independent Hamiltonian path (MIHP) is utilized to cope with radio's multipath effects and interferences, probably caused intentionally. Moreover, with the inherited sequential (Hamiltonian) order to assure maintenance effectiveness and reasonable efficiency, such security-information networks can promote environmental control, and a customer service-oriented image, which are due to the networks' inherent effective sensing, systematic fault-tolerance, working order along wayfinding rational paths and in integrative, urbanism perspectives.

Keywords

Hamiltonian; Radio Interference; Telecommunication; Transportation; Underground Space

Introduction

Vehicles are tools for car-bomb terrorists, stowaways, drug traffickers and other illegal activities for their occlusion in closed mobile spaces. Potential criminals, who have motivation to intrude into the secured environment, may need to process or exchange the prepared settings in the path after the assumed final access check point, even at critical areas, including airports, harbors, tunnels and spaces for important events.

The examination of casino surveillance systems, where more than eight cameras may be required for a game table, helps us to recognize that the line-of-sight environment can be dynamic, pairing of monitoring devices can cooperatively provide better images through the operation of correlated double sampling (CDS) (Damjanovski, 2005). That traffic surveillance employs the use of only one or two cameras installed in the middle of a section of road, which cannot provide left- or right-side views of vehicles in the left- or right-hand traffic system. Moreover, monitored targets can easily be hidden by other vehicles.

In order to sufficiently serve customers via wireless communications, manage the safety issues affected by such as radio interference, surrounding environments, and the system itself certainly need to be counted. In the globalizing era, especially for tourism and other international industries, pondering real-time, integral level-of-services are required in order to attract, protect potential travellers (Sussman, 2000). More specifically, routine maintainace cannot be neglected (Knezevic, 1997), e.g., whether an ineffective compartment exists can essentially harm travellerers' safety, trust feeling, and investores' benefits.

In another perspective, dangerous goods may be attacked in the path at sightline blind spots. Such less-attended dynamics can be more perceived that terrorist activities were often launched serially in a short time after the 9/11 event. In viewing that tourism serves as the critical economical contributor to many communities, their living contexts, should be managed, hierarchially, especially on countrering terrorism (Mansfeld, Y. and Pizam, 2006). Terrorist activities can happen ubiquitously if they are politically demanded. Therefore, future transportation infrastructures–including bicycle/car parking spaces (ARC, 2011; Ashford 2011), should counter unexpected faults (Arthur and Passini, 1992); nevertheless, be arranged lovably, synergistically (Ashford, 2011; Hass, 2008; Pitts, 2004).

Moreover, parking structures, logistics processing stations, or even bus terminals, such vehicles' architectures may be built in closed environment, including (high-rise buildings') basements, which is

often deemed reasonable in high density populated districts. However, real things are that the materials for car-bombs can be easily obtained, and a car-bomb may destroy a whole building by simply softening or breaking an important column. However, such districts can generally be inferred having less terrorism tragedies. Moreover, wireless spoofing or interference devices, including personal privacy devices (PPD) intentionally used by truck drivers to evade legal wireless tracking in the global position system (GPS), may cause dangerous events (Fig.1) (Chen et al., 2009; PNT, 2010; Pullen and Gao, 2012).

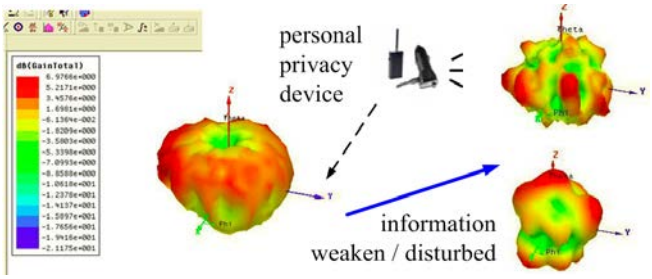

FIG. 1 INFORMATION INTERFERED BY PPD – CONCEPT PRESENTED WITH ANSOFT HFSS SOFTWARE

Literature Review

For adapting to future mobile business environments, including applying pervasive radio frequency identification(RFID) technologies, this paper proposed an approach, which uses existing or relatively low-layer equipment (Chen et al., 2009; Malik et al., 2012), yet with detection availability, maintainability, infrastructural (standard regulation) regularity concerns–specifically on underground, highly metal interfered, and congested locations.

For public safety, countering interference should be deemed in the infrastructure, which may not be used only for the PPD using truck drivers (Pullen and Gao, 2012). Moreover, using relatively low-layer equipment, probably incorporated with other mathematical techniques (Zhang et al., 2012) to pervasively benefit prevent interference issues or promote wireless communication integrity is intended to support quality-assured parking spaces, with possibilities of mobile business services that should be seriously concerned (Tigerman, 2012).

Consequently, dual-surveillance (correlation) based security-information networks are prototyped for better functionality, just as human vision is better with two eyes instead of one. Such a network also can be capable of executing efficient and effective checking or maintenance of a security-information network in a systematically sequential-order environment and allows for more fault-tolerance for real-time traffic management. Moreover, such networks are intended to have the performance of mutually independent Hamiltonian paths (MIHP), by which various environment impact and ill-integrated images or noises can be analyzed.

In vehicles' circulation paths, two rows of parking stalls are typically aligned with a vehicle path. Its center coincides with the helix (Chrest et al., 2001). For example, six nodes are assumed along the helix at certain intervals (a structure bay has two six-node rows), and the main detection direction (forward or backward) can be changed alternatively. The spider web network SW(m,n) is considered because it is found to perform using dual-pair, mutually independent Hamiltonian paths (Hsu, 2012). It can benefit countering multipath effects such as those present in RFID applications. Moreover, it can offer a platform for the area-based security-information networks, which can benefit area-oriented radio/wireless information processing and emergency response (Hsu, 2008). The degree (as the next section) of SW(m,n) is optimal three in terms of offering hierarchical order for maintenance or operation in congested conditions.

The definition and its configurations of spider-web networks will be introduced in the next section. Network's performance, such as systematic operation order, systematic fault tolerance, and integrating connectivity, terminologies Hamiltonian properties, 1p-Hamiltonian and 1-edgs Hamiltonian are introduced respectively in the next section. Then application features are briefly investigated. Finally, the conclusion is given.

Mathematical Preliminaries

Usually, communication networks are represented by graphs in which nodes represent processors and edges represent links between processors. Let $G = (V, E)$ be a *graph* if V is a finite set and E is a subset of $\{(a,b) \mid (a,b)$ an unordered pair of $V\}$. A path is delimited by $(x_0,x_1,x_2,\ldots x_{n-1})$, and called a *Hamiltonian path* if its nodes are distinct and span V. A *cycle* is a path of at least three nodes such that the first node is the same as the last node. A cycle is called a *Hamiltonian cycle* or *Hamiltonian* if its nodes are distinct except for the first node and the last node, and if they span V (Hsu and Lin, 2008).

A *bipartite graph* $G = (V, E)$ is a graph such that $V = A \cup B$ and E is a subset of $\{(a,b) \mid a \in A$ and $b \in B\}$; if G-F remains Hamiltonian for any $F = \{a, b\}$ with $a \in A$ and

$b \in B$, then G is 1_p-*Hamiltonian*. A graph G is *1-edge Hamiltonian* if $G-e$ is Hamiltonian for any $e \in E$; moreover, if there is a Hamiltonian path between any pair of nodes $\{c,d\}$ with $c \in A$ and $d \in B$, then the bipartite graph G is *Hamiltonian laceable*.

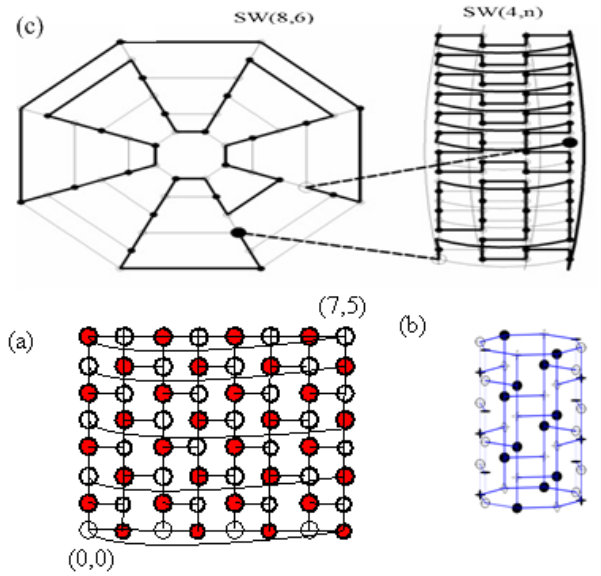

FIG. 2 SPIDER-WEB NETWORK – (a). MATHEMATICAL (PLANAR) PRESENTATION OF SW(8,6), (b). PIPE-SHAPE OF SW(8,6), (c). HAMILTONIAN LACEABILITY OF SW(m,n)

The spider-web network, *SW(m,n)* is a graph (Fig. 2) with the node set $\{(i,j) \mid 0 \le i<m, 0 \le j<n\}$, where m and n are even integers with $m, n \ge 4$, such that (i,j) and (k,l) are adjacent if they satisfy one of the following conditions: (1) $i=k$ and $j=l \pm 1$; (2) $j=l$ and $k=i+1$(**mod** m) if $i+j$ is odd or $j=n-1$; and (3) $j=l$, $k=i-1$(**mod** m) if $i+j$ is even or $j=0$. SW(m,n) is proved 1-edge Hamiltonian; 1_p-Hamiltonian (Kao and Hsu, 2005a). Thus, the fault-tolerance engaged in is systematically based.

Moreover, *SW(m,n)* are *Hamiltonian laceable* (Kao and Hsu, 2005b; Fig. 3). The number of links connecting a node is called the *degree*; a network that regularly has fewer degrees is generally economical. Two Hamiltonian paths $P_1=(u_1, u_2,\ldots,u_{n(G)})$ and $P_2=(v_1,v_2,\ldots,v_{n(G)})$ of G from u to v are independent if $u=u_1=v_1$, $v=u_{n(G)}=v_{n(G)}$, and $u_i \ne v_i$, for every $1<i<n(G)$. A set of Hamiltonian paths, $\{P_1,P_2,\ldots,P_k\}$, of G from u to v is *mutually independent* if any two different *Hamiltonian paths* are independent from u to v. The mechanism of *mutually independent Hamiltonian paths (MIHP)* can be applied to parallel processing (Hsu, 2012). Nevertheless, in this article, such a feature is also considered for secret communications (Lee et al., 2005). The feature of *SW(m,n)* is that m, n should be even, and *SW(m,n)* may also used for a linear one-way or single path.

Significance in Promoting Urbanism

The economy of the sustainable city of the future will be based upon networks of information, whose creative, pervasive contexts will drive the new economy and more lovable/sustainable environments. (Tumlin, 2012; Haas, 2008; Salingaros, 2005). Furthermore, networks related to vehicle architectures, should be concened on reasonable human-centered image, flexible land-uses, long-haul economy- including for example, developing tourism industry synergistically. Three main potential feature directions are discussed as follows

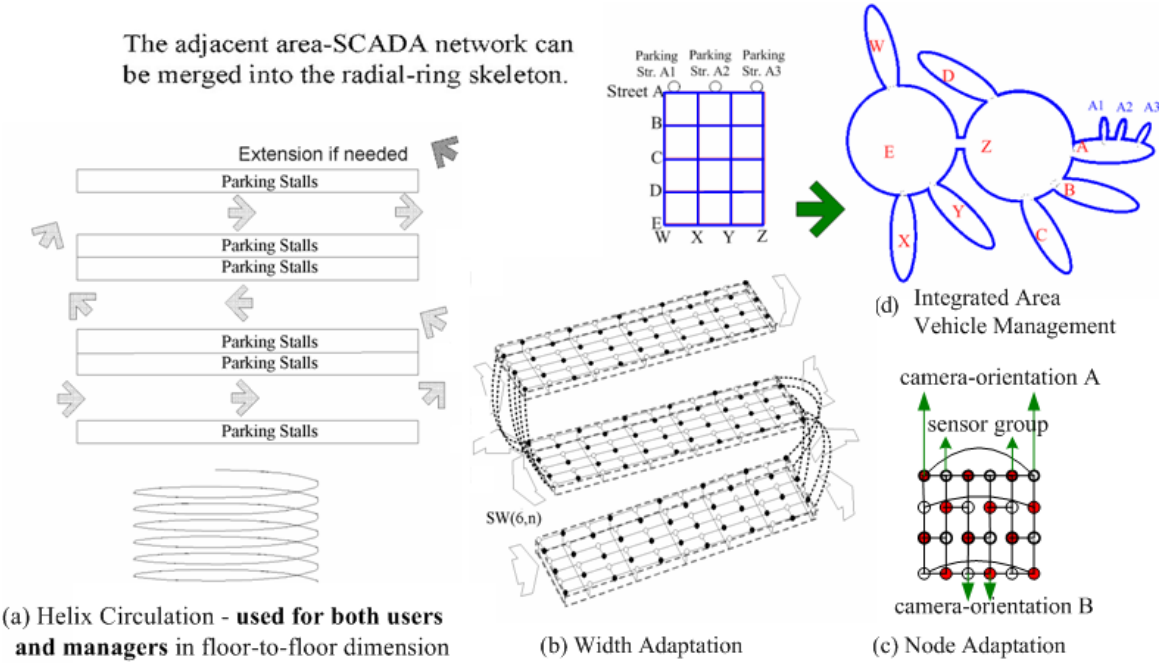

FIG. 3 INTEGRATE SW(m,n) W. VEHICLE CIRCULATION – (a) WAYFINDING RATIONAL CIRCULATION, (b) and (c) ADAPTATION, (d) AREA BASED INTEGRATION

Reliable Parallelism Supporting Network Performance

False detections may happen for many reasons such as multipath effects, node or link (transmission) faults, and a combination of the two. After configuring adaptable dual-surveillance as a basic detection-availability platform, systematic fault-tolerance, connectivity, and management efficiency enhances detection-availability. Furthermore, a diagnostic performance MIHP can be established to analyze time-series related adversary conditions using independent, alternative, time-series recordings for data mining or diagnosing problems, coordinated with the routine inspection. This is similar to physicians employing independent alternatives and time-series records to diagnose a disease.

It must be assumed that rivals are sometimes privy to ciphered information. In order to protect infrastructures, confidential information must be transmitted without alerting such individuals. Therefore, depending only on ciphered words may not always be the best approach for transmitting security-related information. A security network also requires routine maintenance, auditing, and accounting, aspects for which radio-frequency identification can naturally be considered. Such tasks can be operated or managed by different authoritative hierarchies and initiated on random occasions. To maximize efficiency and effectiveness, such routine tasks can be operated in an orderly way through either the entire or the defined part of the network (Knezevic, 1997). This article has proposed a network in which the sequence of such orderly operation can be both flexible and logically adjusted in a Hamiltonian way, because the network has Hamiltonian laceability.

Such routine work may be initiated from different nodes, so that special meanings can be assigned in the operation from both active and passive sides. In other words, the routine operation can be accompanied with special meanings, including any necessary authorization or authentication from its processing sequence and operation scope. The execution of MIHP-related authentication/authorization can also be initiated via RFID, and active RFID can be better reauthorized to deal with privacy issues.

Adaptability to Freight Distribution

Senior citizens represent one of the fastest-growing segments of the population. Therefore, it is important for parking structure design to provide demand-responsive environments in order to best accommodate elderly or disabled individuals (Chrest et al., 2001; Wachs, 2001). Hence, the aforementioned, highly reliable security-information networks can offer continuous and thoughtful protection for parking structure users. It is vital to make pedestrian travel safe and accessible when planning future urban infrastructure. Addressing such significant aspects of safety and welfare can benefit the economic development of various locations in the community.

It is also important to consider the ideal story height for vans which transport the elderly or disabled individuals. The ideal height (i.e., the level of service is A/ LOS-A standard) of a parking garage should be greater than nine feet. Moreover, airport parking structures are typically designed with the LOS-A standard (Chrest, 2001). Such an environment can offer another benefit, since parking spaces would be able to potentially provide an alternative place for freight distribution [Pivo et al., 2002]. It should be mentioned that there is a trend to use smaller trucks with low floors that are quieter in congested cities. Smaller truck capacity can be coordinated with a high-frequency strategy, since timing is a very important issue for contemporary freight services. Small trucks that better facilitate embarkation and disembarkation are developed for urban distribution.

Moreover, accommodations for undersized trucks are especially important to consider for air freight, which generally uses smaller containers (or ULDs) and currently faces a relatively high growth rate, especially in hi-tech products (Shaw, 2007). Air cargo containers are primarily designed for use in the lower deck of an airplane, and they cannot be more than sixty-four inches high. Therefore, the use of small trucks would allow air freight to be handled in our proposed parking spaces. In this study, a feasible pattern for freight distribution was taken into consideration.

Sustainability

The act of strategically keeping freight in transport-ation modes instead of warehousing or inventory stocking often helps to lower the total cost of operation. Hence, from the perspective of place marketing, it is a wise strategy to provide coordinated and flexible alternative spaces for freight handling. Besides, we must also consider the sustainable perspective. For example, if we fail to account for sufficient freight-handling space as an infrastructure element, the logistics of expanding cities may force the use of street space for such a task. Therefore, the result will impact the quality of and available space for pedestrian areas. Urban sprawl, which has been called land-use cancer,

may also result (Eisner, Gallon and Eissner, 1993).

In the event of a disaster, this kind of highly reliable network system can help to prevent potential water damage because of its intricate fire protection design. However, the radio's multipath effect is of concern. Therefore, the proposed networks are better equipped to accommodate the RFID applications and make better use of the closed space, since there is a higher probability of reflection or transmission factors which involve metal or other incompatible materials –i.e., material interference, which cause received information disturbed similar to that caused by the PPD. Hence, the parking space, being well networked as this article's proposal, can be served as an adaptable platform for logistical applications. It can also be used for cross-docking, which is based on the efficient integration of information, facility (including concerns about both fire protection and water damage), and integral transportation systems.

Moreover, the ability to provide the proposed communication networks can allow for the use of more reliable security measures to use land resources, including such as the basements, which are often used for parking areas in the East Asia; however, unsafe in terms of probable terrorism attacks, and prevailing earthquakes.

Furthermore, the flexible and reliable nature of the proposed networks can provide more adaptable means for parking structures, such as logistic stations, museums, offices, or parking spaces for transit vehicles or rental cars Therefore, the proposed networks can contribute to sustainable urban development.

Conclusions

A supervisory control and data acquisition (security-information) network with distributed intelligence is beneficial for integrally managing parking or logistic structures. Mathematical spider-web networks, SW (m,n), can have conformity, adaptability as dual-surveillance based security-information networks along paths. The degree of SW(m,n), three, is optimal in offering hierarchical order for maintenance or operation. For any pair of bipartite nodes, spider-web networks can offer at least two mutually independent Hamiltonian paths (MIHP). With reliability, flexible connectivity, noise-reducibility, and detection-availability, spider-web networks are prototyped as security-information networks for protecting logistic/parking structures.

Similar to physicians' employing independent alternatives and time-series recordings to correctly diagnose the disease, abnormally changing signals and multipath effects of radio/wireless communication can be analyzed via MIHP performance, to improve information reception and prevent false alarms via independent time-series recordings. Classified authentication/authorization can be dynamically inherently implied via the specified sequence of routine operation.

MIHP performance can help to better promote radio frequency identification (RFID) and other wireless communication applications. Such performance also can help to well use parking spaces located at basements, where probabilities of metal interference are relatively high.

Wayfinding assistance, energy conservation, and other environmentally sustainable operations can be designed within parking structures' security-information networks. The system's sequential order can also allow for the management of parking structures while supporting a company's customer-conscious image, since it can assure quality services for the elderly and the handicapped. The proposed networks can reduce the probability of using damaging fire protection equipment. Consequently, parking structures can provide a sustainable means for other possible uses, such as express-delivery stations (Pivo et al., 2002), offices, exhibition spaces (museums), or parking for transit vehicles. Hence, the proposed networks can be extremely beneficial to sustainable urban development.

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